Study washing with water method to remove sodium, potassium and vanadium from Basrah crude oil used as a fuel for boilers and effect on some physical . properties

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:Abstract

Some metals in crude oil of Basrah and some physical properties (density, specific gravity, viscosity) were studied in this paper contents of sodium potassium and vanadium found high so that the crude oil should be treated before using as a fuel in boilers, washing method used to remove or decrease sodium, potassium the results showed that sodium content decreased sincerely with 10% content and also with 6%, 4% and 2% the same behaviour also with potassium. Washing method did not effect on vanadium content because it content stayed with out change, no effective change in physical properties. Flame photometer and UV spectrophotometer were used in .analytical process, density flask method for densities and viscometer for viscosity

:Introduction

Using of heavy fuel oils in industrial furnaces and boilers is known to produce a host of corrosion and environmental related problems. Severe corrosion in hot and cold zones of the furnace and emissions of obnoxious gases, particulates and acid smut to the atmosphere are a few to name which will cost millions by way of forced shut downs and unscheduled maintenance, besides creating environmental .(pollution(1

Vanadium and sodium are two metals that can cause significant problems in bunker fuel combustion with find sulphur. High levels of these metals in the fuel can result in the formation of adherent slag that can cause fouling and corrosion problems in diesel engine cylinders, valves, turbochargers and exhaust gas systems. In addition, vanadium based slag deposits can also catalyze formation of sulphur trioxide (SO_3) from sulphur dioxide (SO_2) in the exhaust gas. In the presence of condensed moisture, SO_3 reacts to form sulphuric acid, which can cause corrosion in exhaust gas handling systems. Additives are available that can minimize the harmful effects of vanadium

and sodium contaminants in the fuel oil. These additives typically contain magnesium based compounds that prevent the formation of adherent, corrosive slag and reduce (the catalytic effects of vanadium compounds on SO_3 formation (2.

Sodium present as NaCl in the oil vaporizes and reacts with SO_3. Subsequent reactions between V and Na compounds result in the formation of complex vanadates having melting points lower than those of the original compounds. The various (reactions can be summarized as follows (3

(NaCl ⟶ Na_2O (vaporization followed by oxidation

$Na_2O + SO_3$ ⟶ Na_2SO_4

V oxidation V_2O_5

$Na_2SO_4 + V_2O_5$ ⟶ $2NaVO_3 + SO_3$

M.Point C 902k ⟵ 964 k 1150k.

Sodium in the fuel reacts with sulphur trioxide and the vanadium oxides to form relatively low Melting point salts such as sodium vanadyl, vanadate, sodium sulphate, etc. These can cause corrosion in superheat areas and at the cold end (sodium acid sulphates). Sodium can be removed from the Fuel oil to a large extent by many ways one of them water washing with approximately 5% of water followed mechanical (process to remove the water or by using drying agent (4.

Washing involves addition of water to the fuel and subsequent removal of the contaminant laden water washing is done to remove the water soluble trace metals Such as sodium, potassium and certain calcium component. The successful washing process depends on a difference between the specific gravities of the fuel and that of the water .Fuels with specific gravities (0.98) or above may not be washable unless thy are first blended with a compatible liquid which has a lower specific gravity such as distillate fuel, the water separate by centrifugal force or electrostatic force and settling process, vanadium cannot be removed through the washing process. It inhibited by the addition of magnesium compounds to the fuel in a certain ratio the corrosive vanadium pentoxide that is formed during combustion reacts to form magnesium orthovanadate. This has a melting point sufficiently high to allow its passage downstream through the turbine with deposition that is easily removed, and (without resultant corrosion. (5.

This paper concentrated on the studying the physical properties and some metals content accompanying crude oil. This crude oil come from Basrah fields of oil and mixing with residual crude oil that come from Al-Nasiriyah refinery plant to use in the boilers of Al-Nasiriyah power station .problems of hot corrosion and precipitating salts on the boilers surfaces appeared and causing damage of boilers piping and unscheduled shut-down of this boilers . Table (1) shows some physical properties of Basrah crude oil for the years 2004-2008 and also shows the percentage of some metals that effect on the combustion process and causing problems for the .(same period mention above (6,7

Table (1) physical properties and some metal contents for .Basrah oil during 2004-2008

property	unit	Basrah crude oil	
		minimum	maximum
density	Gm\cm^3	**0.85**	**0.863**
Specific gravity	-	**0.864**	**0.904**
kinematic Viscosity at 40C	mm^2\sec	**35**	**72**
Water content	%Vol	**0.01**	**0.6**
Ash content	%Wt	**0.003**	
Carbon residue	%Wt	**3**	**7**

Calorific value	Kcal\kg	**10257**	**10684**
Sodium	ppm	**33**	**116**
Sulphur	%Wt	**0**	**3**
Vanadium	ppm	**14**	**65**
Lead	ppm	**0**	**0.15**
chromium	ppm	**0**	**1.4**

Experimental part

Four samples from crude oil were taken (50 ml volume of any sample) from the original sample of the crude oil of Basrah field crude oil after measuring the physical properties and some metals content the water added with ratio of 2,4,6 and 10% respectively ,the new metal content measured and measuring the new physical properties after addition .metal contents measured by using Flame photometer and . UV devices the above specification measured after removing water from the samples The water was remove by centrifuge firstly and by settling process , the samples . left four days to separate water layer from crude oil layer

The four samples of crude oil shown in figure (1). Figure (2) shows the centrifuge that use to separate water and after that the samples left for settling for four days. The centrifuge type (HERML Z200A)Japan and the velocity was (2000rpm), figure(3) and figure (4) show flame photometer and UV spectrophotometers that used in measuring of metals content .The flame use for sodium , and potassium ,this flame type (corning Flame Photometer 410).other metals determined by using UV device ,computerize UV type (T60U Spectrophotometer from PG instrument Ltd company),by using UV any metal content can determine

with available suitable standard .Flame photometer used in sodium and potassium can . also measure lithium in any sample but this metal did not consider in our study

Figure (1) samples of crude oil

Figure (2) centrifuge use in separation processes

Figure (3) flame photometer that used in sodium content .measuring

Figure (4) UV .spectrophotometer used in vanadium and another metals measuring

Results and discussion

.(The results of tests before and after water addition recorded in table (2

.Table (2) physical properties and some trace metals content

Property	Before treating	After treating and removing water that using in treatment			
		2% water	4% water	6% water	10% water
Density gm/cm^3	**0.858**	**0.89**	**0.90**	**0.901**	**0.909**
Specific gravity	**0.866**	**0.911**	**0.912**	**0.918**	**0.919**
Kinamatic viscosity at 40C m^2/sec	**33.03**	**33**	**33**	**32.3**	**32**
Sodium content ppm	**116**	**101**	**97**	**83**	**71**
Potassium content ppm	**134**	**90**	**87**	**87**	**85**
Vanadium content ppm	**37**	**36**	**34**	**34**	**33**

From observing the results of tests that recorded in table (2) the following notices can .be seen

The value of sodium content was high before addition and this oil need to treatment before using it as a fuel in the boilers to decrease hot and cold corrosion problems .From the same table sodium content decreased clearly after addition of water ,the high percentage of decreasing with 10% addition but at the same time

needing to efficient operations for water removing ,the sodium content also decreased with 6%,4% and 2% but less than 10% so that recommended 10% addition with efficient water separation processes ,if any increasing in water addition than 10% . expect of the water content problems will appear

The results showed that washing of crude oil with water effective to decreasing sodium content. Figure (5) shows changing sodium content with water addition .percentage

.Figure (5) decreasing sodium content with increasing water addition

The content of potassium also decreased by increasing water addition and this shown in table (2) and appears clearly in figure(6). This behaviour give an evidence that potassium and there compounds can be removed by washing with water like sodium .and its compounds

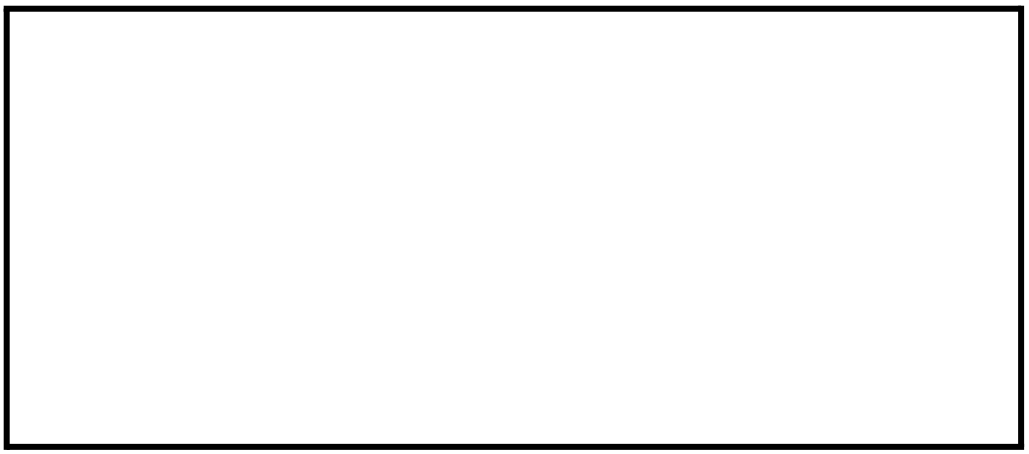
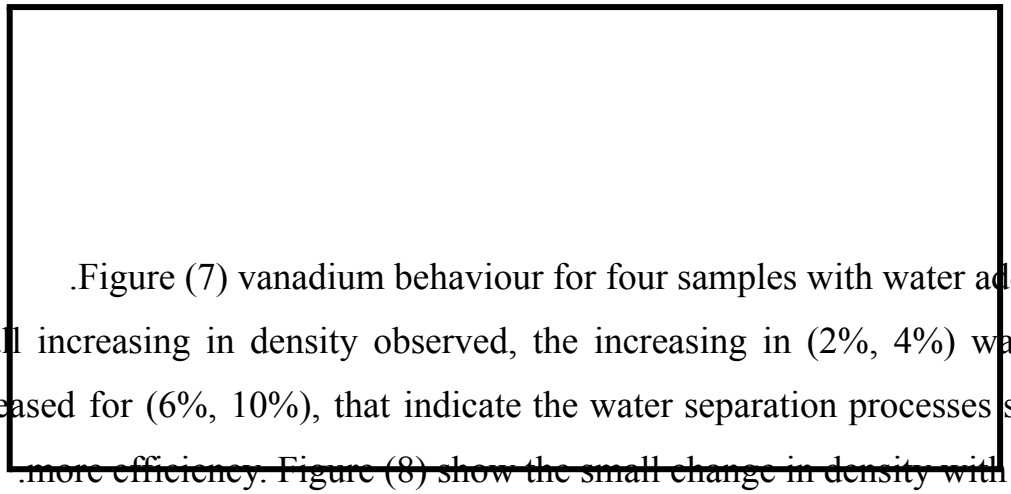


Figure (6) changing potassium content with water addition

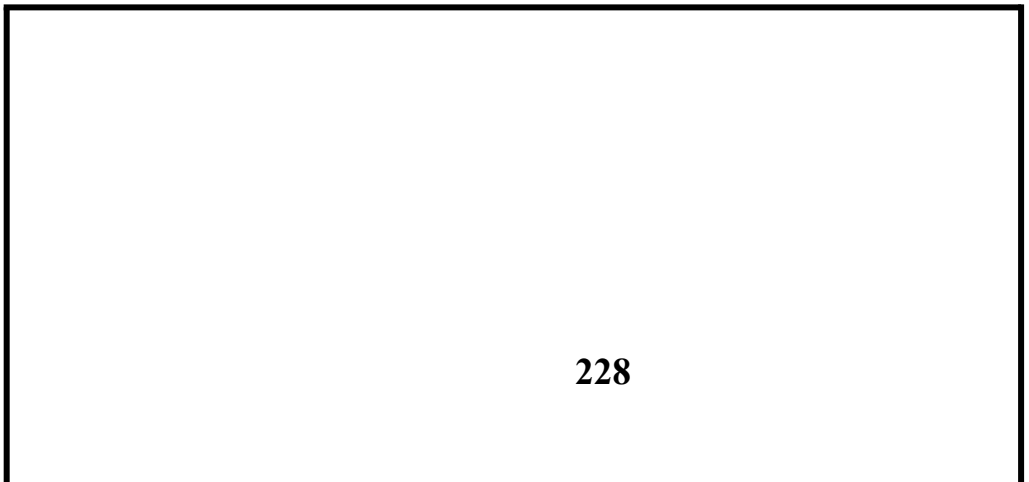
Vanadium content also high before treatment and that mean the problems of vanadium (hot corrosion) will appear without treating this fuel , from table(2) no sensible decreasing in vanadium for all treatment processes because vanadium insoluble in water and can not be removed by fuel washing ,Vanadium soluble in hydrochloric and sulphuric acid as well as in alkali at normal temperature (8) , inhibition of vanadium problems achieved through the use of chemical additives, Additives for hot corrosion inhibition are based on magnesium, although some commercial additives also contain other elements including silicon, chromium, and aluminium for special applications(1). There are three generic types of magnesium based additives: water-soluble, oil-soluble, and oil dispersible. Magnesium sulphate (Epsom salt) is the water-soluble additive. It is used as a 10 to 20 percent water solution of magnesium sulphate which must be emulsified into the fuel.. Oil-soluble inhibitors are proprietary products which blend readily and uniformly in the fuel to form stable mixtures. Oil dispersible inhibitors are stable suspensions of very finely divided solid magnesium compounds, oil-dispersible inhibitors form stable mixtures (in the fuel if some mixing is provided (4.

(Behaviour of vanadium for all samples of study shows clearly in figure (7.



.Figure (7) vanadium behaviour for four samples with water addition

Small increasing in density observed, the increasing in (2%, 4%) was so small but increased for (6%, 10%), that indicate the water separation processes should be need more efficiency. Figure (8) show the small change in density with water addition.



.Figure (8) the small change in density with water addition

Kinematic viscosity measured by using viscometer and from results in table (2) no .significant change in viscosity for all samples

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